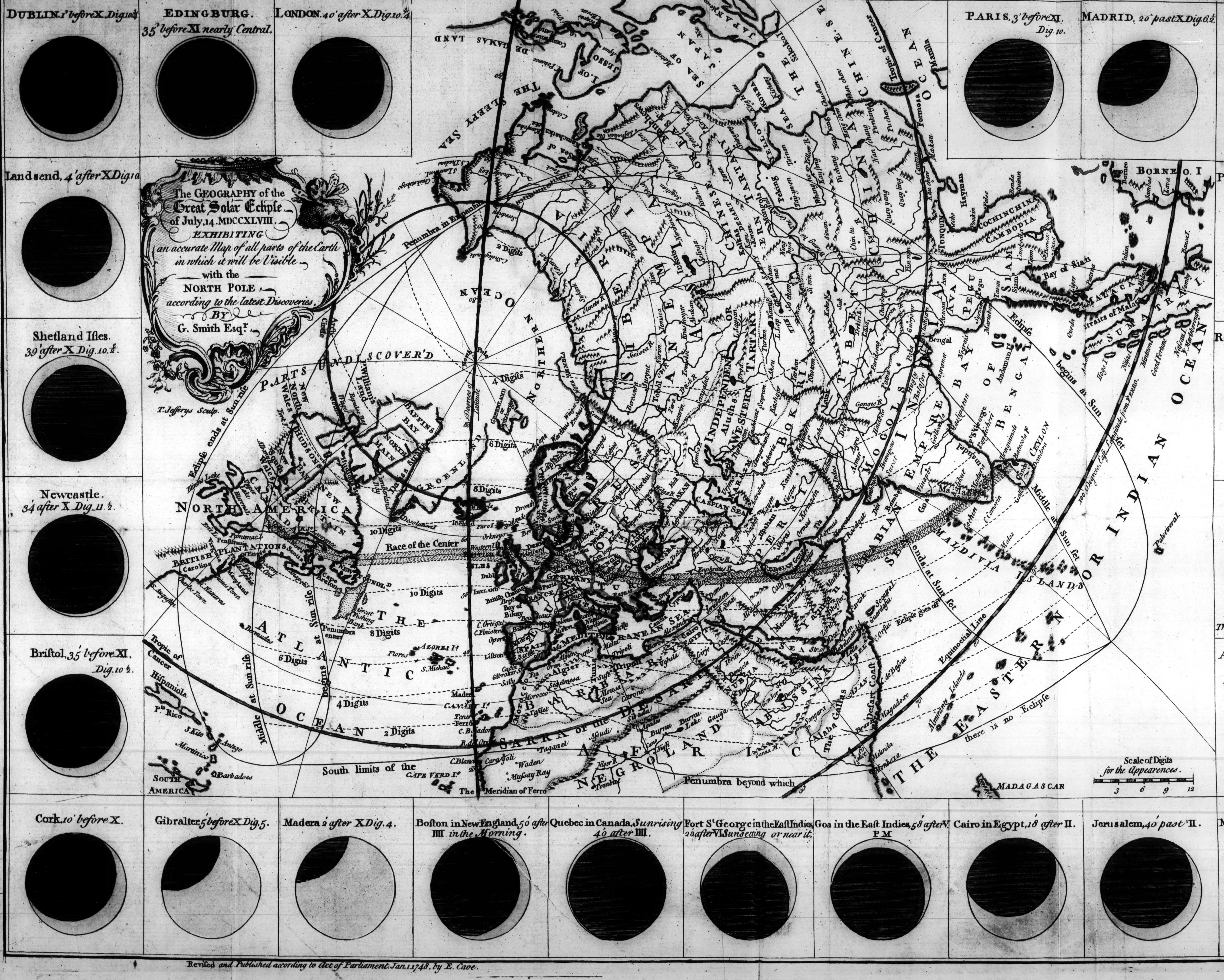

DUBLIN. 1' before X. Dig. 10¾
EDINGBURG. 35' before XI nearly Central.
LONDON. 40' after X. Dig. 10.¾
PARIS, 3' before XI. Dig. 10.
MADRID, 20' past X Dig. 6.½.
VIENNA, 10' past XII. Dig. 11.¼.
Landsend, 4' after X Dig. 10
Shetland Isles. 39' after X Dig. 10.½.
Newcastle. 34' after X. Dig. 11.½.
Bristol, 35' before XI. Dig. 10½.
PETERSBURG, 26' after I.
ROME, 2' after XII Dig. 9.¾.
CONSTANTINOPLE, 10' before XI Dig. 11.
The Same at Hanover, 26' after XI.
Archangel, 20' after II Dig. 6.
Cork, 10' before X.
Gibralter, 5' before X Dig. 5.
Madera 2' after X Dig. 4.
Boston in New England, 50' after IIII in the Morning.
Quebec in Canada, Sunrising 40' after IIII.
Fort S^t George in the East Indies, 20' after VI Sunsetting or near it.
Goa in the East Indies, 58' after V. PM
Cairo in Egypt, 18' after II.
Jerusalem, 40' past II.
Moscow, 20' after II Dig. 7.½.
T. Jefferys Sculp.
Eclipse ends at Sun rise
Middle at Sun rise
begins at Sun rise
South limits of the
Penumbra beyond which
there is no Eclipse
Penumbra in
Race of the Center
Eclipse goes off
ends at Sun set
Middle at Sun set
Eclipse begins at Sun
Arctic Circle
Tropic of Cancer
Equinoctial Line
The Meridian of Ferro
100 Degrees, East Longitude from FERRO.
Degrees of Latitude
2 Digits
4 Digits
6 Digits
8 Digits
10 Digits
PARTS UNDISCOVER'D
NORTHERN OCEAN
NORTH AMERICA
BRITISH PLANTATIONS
THE ATLANTIC OCEAN
SOUTH AMERICA
GREENLAND
SIBERIA
INDEPENDENT WESTERN TARTARY
CHINESE OR EASTERN TARTARY
BOKARIA
TIBET
CHINA
PERSIA
ARABIA
MOGOLS EMPIRE
INDIA
BAY OF BENGAL
AFRICA
NEGROLAND
SARRA or the DESART
BARBARY
ABISSINIA
THE EASTERN OR INDIAN OCEAN
THE CHINESE OCEAN
SEA OF JAPAN
JAPAN
THE SLEEPY SEA
MALDIVIA ISLANDS
SUMATRA I.
BORNEO. I
CEYLON
MADAGASCAR
Scale of Digits for the Appearences.
3
6
9
12

The GEOGRAPHY of the Great Solar Eclipse of July, 14. MDCCXLVIII.
EXHIBITING
an accurate Map of all parts of the Earth in which it will be Visible
with the
NORTH POLE
according to the latest Discoveries.
BY
G. Smith Esq^r.

Revised and Published according to Act of Parliament. Jan. 1. 1748. by E. Cave.

912

A
DISSERTATION
ON THE
General Properties
OF
ECLIPSES;

And particularly the enſuing E-
CLIPSE of 1748, conſidered thro'
all its Periods.

By GEORGE SMITH, *Eſq*;

LONDON:
Printed for E. CAVE, at *St John*'s *Gate*, and
ſold at the Pamphlet Shops. 1748.

BRITISH MUSEUM

A DISSERTATION, *&c. on* ECLIPSES.

WE have no record of any *Eclipſes* being obſerv'd 'till after *Nabonaſſar*'s days. This monarch having eſtabliſhed a ſchool of *Ægyptian* aſtronomers at *Babylon*, they began to collect a ſeries of theſe aſtoniſhing phænomena, in order to compleat their cæleſtial theory, and ſee if they could inveſtigate their cauſes, and aſſign their returns. Accordingly they obſerv'd one as early as 721 years before Chriſt, about 26 after the foundation of their College; but it does not appear, from all their regiſters, that they ever attain'd to the knowledge of their computations by previous calculation; tho' by the number of years aſſign'd for their return, which was eighteen, with 10 or 11 days, more or leſs, as the Biſſextile falls out, 'tis evident that they had made conſiderable progreſs before the deſtruction of *Babylon* by *Alexander*; yet we cannot think that they had tables for correcting the anomalies of that period, or computing ſucceeding eclipſes *a priori*.

Thales was the firſt of the *Grecian* aſtronomers, that foretold the ſolar eclipſe which happened in the fourth year of the 48th *O-*

lympiad, or the 580th before Chriſt; but 'tis moſt likely he had the prediction elſewhere, as we find no tables exiſtent till long after the redemption, which could with the leaſt certainty explain or foretel theſe appearances.

The *Chaldean* period of 18 years, with ten or eleven days, generally throws the eclipſe near eight hours later with regard to the time of day, ſo that if the firſt eclipſe happen about noon, the return of it after that interval will be near eight at night; and when theſe obſcurations happen about the ſummer ſolſtice, all the whole three periods may be ſeen in *Britain*, but in winter only one of theſe, ſo that the time of the year greatly affects the circumſtances of ſolar eclipſes.

As eight hours in three periods make juſt one day, ſo in 54 years and about a month, theſe returns will nearly correſpond to the time of day, and bring the eclipſe with much the ſame affections to every particular place, the difference lying chiefly now betwixt the greater or leſſer obliquity of the earth's axis, and the variation of the moon's node.

In eclipſes about the ſolſtices the parallels of latitude are cut at ſmall angles, and the difference of the latitudes of the central ingreſs and exit, depends altogether on the poſition of the axis of the lunar circle to the earth's. But in eclipſes about the equinoxes theſe latitudes are widely different, and the meridians cut at ſmall angles, contrary to what happens in the ſolſtices.

The ſhade generally has its moſt northern limit in the illuminated hemiſphere, ſometimes to the eaſt and ſometimes to the weſt of the general meridian.

After the ſhade arrives at its moſt northerly limit, it from thence declines continually ſouthward, till it arrives at the oppoſite point of deflection, which two points are ſeldom or never in the diſk at one time, except in ſome very particular caſes.

In the preſent eclipſe, for example, it enters the earth amongſt the *French* ſettlements in *Canada* central, and paſſes continually more north, till it arrive in latitude 57° 38′; from that point it bends ſouthward continually till its exit, near fort *St George* on the *Indian* continent; this point is to the weſt of *Britain*, becauſe it croſſes *Scotland* betwixt 56° and 57°, diminiſhing, which is leſs than its moſt northerly approach.

This contrary flexure is not occaſioned by any irregularity of the lunar motions, but entirely by the poſition of the earth, and muſt be common to all eclipſes, becauſe of different ſituation of the earth's and moon's axes; and even when theſe co-incide, it will be at times when no paralleliſm can happen betwixt the path of the ſhade and place; for the laſt is always elliptical, except at the equinox, when the angle of the axis is 23° 29′ from the ecliptic, and that of the moon can never exceed 6 degrees. Now as the way of the ſhade is ſo near a ſtrait line, that we always delineate it as one on the diſk, and the path of the place is always a curve, except in the circumſtances ſpecify'd, of the elliptic kind, all right lines that cut any ellipſis in one point muſt paſs out of it again, and ſo the ellipſis of the moſt northerly contact will be no more touch'd by the moon's way, which will afterwards continually keep ſouth of it, till it would arrive at a point, of the moſt ſoutherly approach, if the progreſs continu'd till that time.

The compleat revolution of ſolar eclipſes will be a period nearly equal to half of the *Annus Magnus*, or 12,000 years, but 1000 of theſe, or about ſixty *Chaldean* periods, generally exhibit all their variety to this globe; the far greater part of that revolution is expended on the ætherial ſpaces of the univerſe, within the circumſcription of the ſhade, and never reach the earth at all: In ſome of theſe ſpaces every moment has a ſolar eclipſe ſince the creation of things, and the number of thoſe aſſign'd to the Earth are comparatively almoſt nothing to thoſe of the expanſum.

To illuſtrate this a little farther, we ſhall examine ſome of the moſt remarkable circumſtances of the returns of the eclipſe which happens *July* 14, 1748, about noon: This, after traverſing the voids of ſpace from the creation, at laſt began to enter the *Terra Auſtralis incognita*, about 88 years after the conqueſt, which was the laſt of king *Stephens*'s reign; every *Chaldean* period it has crept by degrees more northerly, but was ſtill inviſible to any part of the *Britiſh* iſles before the year 1622, when on the 30th of *April* it began to touch the ſouth points of *England* about 2 in the afternoon, its central appearance riſing in the *American* ſouth ſeas, and traverſing *Peru*, and the *Amazons* country thro' the *Atlantic* ocean into *Africa*, and ſetting in the *Æthiopian* continent, not far from the beginning of the Red Sea.

Its next viſible period was after three *Chaldean* revolutions in 1676, on the firſt of *June*, riſing central in the *Atlantic* ocean, paſſing us about 9 in the morning with four digits eclips'd on the under limb; this ſet in the gulph of *Cochinchina*, in the *Eaſt Indies*.

It being now near the ſolſtice, was, for reaſons already given, viſible the very next return in 1694 in the evening; and in two periods more, which was in 1730, on the 4th of *July*, was ſeen above half eclips'd juſt after ſun-riſe, and obſerv'd both at *Wirtemberg* in *Germany*, and *Peking* in *China*, ſoon after which it went off.

Eighteen years more afford us the eclipſe now to happen on the 14th of *July*, with the phænomena already deſcrib'd; and thoſe who deſire to look more narrowly into its particular affections, may conſult the annexed map of it over the earth, which illuſtrates by inſpection only. However, to ſatisfy the curious, I ſhall continue the revolutions till their expiration.

The next viſible return will happen in 1766, in the evening, about four digits eclips'd, *July* 25th; and after two periods more on *Auguſt* 16, 1802, early in the morning, about five digits, the centre coming from the north frozen continent by the capes of *Norway*, thro' *Tartary*, *China*, and *Japan*, to the *Ladrone* iſlands, where it goes off.

Again in 1820, *Aug.* 26, betwixt 1 and 2, there will be another great eclipſe at *London* above 10 digits, but happening ſo near the equinox, the centre will leave every part of *Britain* to the weſt, and enter *Germany* at *Emden*, paſſing by *Venice*, *Naples*, *Grand Cairo*, and ſet in the gulf of *Baſſora*, near that city.

It will be no more viſible 'till 1874, when 5 digits will be obſcur'd, the centre being now about to leave the diſk on *Sept.* 28. In 1892, the ſun will go down eclips'd at *London*, and again in 1928 the paſſage of the centre will be quite in the expanſum, tho' there will be 2 digits eclips'd at *London* *Oct.* the 31*ſt* of that year; and about the year 2090 the whole penumbra will be wore off, whence no more returns of this eclipſe can happen 'till after a revolution of 10000 years.

From theſe remarks on the entire revolution of this eclipſe, we may gather that 1000 years more or leſs (for there are ſome irregularities that may protract or lengthen that period 100 years) compleat the whole terreſtrial phænomena of any ſingle eclipſe; and ſince 20 periods of 54 years each, and about 33 days, comprehend the entire extent of their revolution, 'tis evident that the times of the return will paſs thro' a circuit of 1 year and 10 months, every return of the *Chaldean* period 10 or 11 days later, and of the equable appearances, about 32 or 33 days. Thus tho' this eclipſe happens about the middle of *July*, no other ſubſequent terreſtrial eclipſe of this period will return to the middle of the ſame month again, but wear conſtantly each period 10 or 11 days more forwardly, and at laſt appear in winter, but then it begins to ceaſe from affecting us.

Another concluſion from this revolution may be drawn, that there will ſeldom be any more than two great eclipſes of the ſun in the interval of this period, and theſe ſometimes follow next return, and often at greater diſtances. That of 1715 return'd again in 1733 very great, but this preſent eclipſe will not be great till the arrival of 1820, which is a revolution of four *Chaldean* periods, ſo that the irregularities of their circles muſt undergo new computations to aſſign them exactly.

Nor do all eclipſes come in at the ſouth pole; that depends altogether on the poſition of the lunar nodes, which will bring in as many from the expanſum one way as t'other, and ſuch eclipſes will wear more ſoutherly by degrees, contrary to what happens in the preſent caſe.

The eclipſe, for example, of 1736, in *September*, had its centre in the expanſum, and ſet about the middle of its obſcurity in *Britain*; that will wear in at the north pole, and in the year 2600, or thereabouts, paſs off into the expanſum on the ſouth ſide of the earth.

The eclipſes therefore which happen'd about the creation, are little more than half way yet of their ætherial circuit, and will be 4000 years before they any more enter the earth. This grand revolution ſeems to have been wholly unknown to the antients.

I come now to conſider them in another light, as it appears before their reduction to computation; their remarkable phænomena in the two great lights of the earth, afforded proper ſubject to the *Jewiſh* prophets to borrow alluſions, and even make uſe of their revolutions to point out the enſuing iſſue of their prophecy.

This will be more evident, if we attend to the other prophetic threatnings as deduc'd, from the eſtabliſh'd laws of nature, either as fore-runners of ſome general calamity, or as penal ſufferings inflicted on the delinquencies of that people; ſuch as famine, peſtilence, war, dreams, earthquakes and the like; not that theſe ſignals were the cauſe of the evil, but certain diagnoſtics foreſeen by the prophets to precede it.

Again, the particular nation threatned had moſt frequently ſome one of its darling objects, taken either in knowledge, idolatry, or any other favourite ſcheme. Thus the images of *Moab* are threatned to be removed from them; the *Ægyptians* on the other hand had their *Nile*, the fountain of all their wealth ſpoke againſt, " to be ſmitten in all its ſeven channels", &c. the *Tyrians* their ſea, &c. as is evident from inconteſtable proofs in the *Jewiſh* writings.

Hence nothing could be fixt on by a prophet more emphatical to point forth the deſtruction of *Babylon*, than ſome aſtronomical phænomenon, as that was the principal ſtudy of theſe people; and nothing indicates the ſupernatural authority of the prophets more than foretelling theſe remarkable events, before there were the leaſt tables made for ſuch computations, or indeed before any mathematical hypotheſis was ſuffer'd about them, being looked on as the aſtoniſhing miracles

of

nature, and not to be accounted for by the then rational theory.

It muſt therefore be conſonant to the ſyſtem of prophecy, to prefigure the deſtruction of an aſtronomical city, by ſigns taken from their own theory. And this will appear the caſe, if we attentively examine thoſe prophets who particularly directed their menaces to *Babylon*; I ſhall at preſent only mention *Iſaiah*.

That writer having pointed out the pride of the *Chaldean* learning, the multitude of her aſtronomers and ſtar-gazers, in his 47th chapter, and their ridiculous pretenſions to prognoſticate the fate of nations by the aſſiſtances of ſuch ſciences, tells them, their own deſtruction was coming like a torrent, which they could not foreſee, though the ſign would be amongſt their ſtars, which they principally ſtudy'd, and their two grand lights. Your deſolation, ſays he, is coming from a far country, from the kingdoms of nations, and when you ſee theſe ſigns be ſure it will follow.

The ſtars of heav'n, to wit the קסילים (Keſilim) *thereof ſhall be hid, the ſun ſhall be darkned in his going forth, and the moon ſhall withdraw her light.* Iſaiah xiii. 10.

Accordingly the whole prophecy was literally compleated, the *Keſilim*, or *Hyades*, were eclipſed by the moon, the ſun was darkned totally over the *Babylonian* empire at his going forth, or ſetting, and the moon was likewiſe totally eclips'd, all regularly after each other, in the 4th year of the 48th *Olympiad*, not many years before the deſtruction of that city. And as this was the ſolar eclipſe predicted by *Thales*, 'tis not difficult to conjecture whence that aſtronomer might gather his light; and tho' *Iſaiah* did not point out the particular year in his prophetical writings, we can hardly ſuppoſe him ignorant even of that, as he gives ſo many concurring circumſtances to ſtrengthen the event of his prediction.

The ſupernatural eclipſe at the paſſion of *Chriſt* ſeems very manifeſtly foretold by *Zechariah* xiv. 6. For as they were divinely inſpired, the miraculous accidents in nature were the ſame to them as thoſe which after ages might be capable of deducing from the eſtabliſhed theory of things, though impracticable to the aſtronomers of thoſe days.

Likewiſe the great ſolar and lunar eclipſe, which preceded the deſtruction of *Jeruſalem*, ſeems elegantly hinted at by *Chriſt*, *Mathew* xxiv. 29.

But notwithſtanding the prophets made uſe of thoſe phænomena as ſigns, they being no cauſe of the event, nor having any relation to the myſteries of futurity, nothing can now be made out from their particular tranſits, as divine inſpiration has ceaſed, even granting that they precede ſome diſaſter to a particular people, becauſe we cannot argue from cauſes that have no viſible connection to events of a different nature. The *Jewiſh* prophets foretold the circumſtances that would go before, and the diſaſters that would follow; they even pointed out the nation that was to effect it, though frequently there was not the leaſt apprehenſion or ground for ſuch a concluſion. Thus *Iſaiah*, foretelling the deſtruction of *Tyre* and *Zidon*, ſays it would be from a people they little expected, a city that had no being 'till the *Aſſyrian* built it, that t'other day only the *Arabian* ſhepherds had pitched their tents where that miſtreſs was getting up that would be their end, even the city of the *Chaldeans*; *Iſaiah* xxiii. and elſewhere in his prophecies againſt *Tyre*. And when our modern Judicialiſts go as evidently to work with their concluſions, we may then give aſſent to their predictions; otherwiſe, *credat Judæus Apella*.

Nothing beſides, of any certainty, can be deduced from a phænomenon ſo uncertain in its riſe, progreſs, and exit. Many eclipſes come in on the ocean, in uninhabited countries about the north pole, and never reach the ſight of man at all, and no concluſion can be inferred to any people from theſe; but when minds are diſpos'd to imbibe enthuſiaſm, they will eaſily draw inferences from independent cauſes.

Thus, in 1724, the ſun went down totally eclips'd over *Genoa*; its cataſtrophe followed in 1747; at *Dantzig* the ſame, and in 1733 that city was taken by the *Ruſſians*; in 1737 the eclipſe came in at *Porto Bello*, that mart deſtroyed by admiral *Vernon* a few years after; the ſame came over *Scotland* ſoon after mid-day, the rebellion in 1745; ſet at the mouth of the river *Kimen* in *Finland*, that province ruined by the *Ruſſians*, and the river like to become a ſource of new contentions. Now if ſome great and ſignal calamity happen to *Quebec* and the *French* ſettlements in *Canada*, or to fort *St George* in the *Eaſt Indies*, the riſe and exit of the great enſuing eclipſe; and if the time of its completion be diſtinctly marked out, or the people that are to effect it, and the circumſtances that will attend it, ſomething may be done to ſtrengthen aſtrology; otherwiſe accumulations of myſtic ſentences, and ambiguous evaſions, look more like the heathen oracles, than the temple of *Zion*, and will never gain ground with the more judicious part of mankind, till better ſupported.

P.S. It is particularly to be noted, that eclipſes, which have happened many centuries ago, will not be found by our preſent tables to quadrate exactly with antient obſervations, by reaſon of the great anomalies in the lunar motions; which appears an inconteſtable demonſtration of the non-eternity of the univerſe. For it ſeems confirmed by undeniable proofs, that the moon abſolves her period in a ſhorter compaſs of time than formerly, and will continue by the centripetal law to accelerate in velocity as ſhe approaches the earth; nor will the centrifugal power be found ſufficient to compenſate the different gravitations of ſuch an aſſemblage of bodies as conſtitute this mighty fabric, which would ruſh to ruin of itſelf, without proper aſſiſtance to regulate and adjuſt it to its original motions.

Thus we are credibly aſſured, from the teſtimony of the antients, that there was a total eclipſe of the ſun predicted by *Thales* to happen in the fourth year of the 48th *Olympiad*, either at *Sardis* or *Miletus* in *Aſia*, where this aſtronomer then reſided. That year correſponds to the 585th before *Chriſt*, when accordingly there happened a very ſignal one on the 29th of *May*, anſwerable to the preſent 10th of that month, central through *North America*, the ſouth parts of *France*, *Italy*, &c. as far as *Athens*, or the iſles in the *Ægean* ſea, which is the fartheſt that even the *Caroline* tables carry it, and conſequently make it inviſible to any part of *Aſia* in the total character, tho' I have good reaſons to believe that it extended to *Babylon*, and went down central over that city. We are not however to imagine that it was ſet before it paſt *Sardis*, and the *Aſiatic* towns where the predictor lived, becauſe an inviſible eclipſe could have been of no ſervice to demonſtrate his ability in aſtronomical ſciences to his countrymen, as it could give no proof of its reality.

For a farther illuſtration; *Thucydides* the hiſtorian relates, that a ſolar eclipſe happened on a ſummer's day in the afternoon, in the firſt year of the *Peloponneſian* war, ſo great that the ſtars appeared. *Rhodius* was victor in the *Olympic* games the fourth year of the ſaid war, being alſo the fourth of the 87th *Olympiad*, or the 428th before *Chriſt*. So that the eclipſe muſt have happened in the 431ſt before *Chriſt*, and by computation it appears that on the 3d of *Auguſt* (about the 17th of our preſent *July*) there was a ſignal eclipſe, which would have paſt over *Athens* central about ſix in the evening, but which our preſent tables bring no farther than the antient *Syrtes* on the *African* coaſt, above 400 miles from *Athens*, which ſuffering in that caſe but 9 digits, could by no means exhibit the remarkable darkneſs recited by the hiſtorian; the center ſeems therefore to have paſt *Athens* about ſix in the evening, and probably might go down about *Jeruſalem*, or near it, contrary to the conſtruction of the preſent tables. I have only obviated theſe things by way of caution to the preſent aſtronomers, in re-computing antient eclipſes, and refer them to examine the eclipſe of

Nicias ſo fatal to the *Athenian* fleet, that which overthrew the *Macedonian* army, &c. from the annals of hiſtory, becauſe the tedious proceſs of calculations is foreign to my deſign. Mean time I ſhall note down 10 or 12 remarkable eclipſes, that will be viſible at *London* in the compaſs of 800 years, as they may ſerve for a future ſtandard to ſucceeding aſtronomers, in aſcertaining the quantity of this increaſed velocity of the lunar motions, for which a proper table may be compoſed, to regulate, with more certainty, eclipſes of great antiquity; as they will have larger opportunities to gratify their knowledge, and confirm this conjecture, from the numerous regiſters of thoſe phænomena daily publiſhed.

At *LONDON.*

Table of 12 *Solar Eclipſes to happen in* 800 *Years.*

1842 *June* 26, 8′ before VI. manè Dig.
10¼ center to the ſouth.
1860 *Sept.* 26, 2′ after VIII. manè Dig.
11¼ center a little ſouth.
1927 *June* 16, 33′ paſt V. manè Dig.
11 center to the north.
1999 *July* 28, 4′ before XI. manè Dig.
11½ center a little ſouth.
2075 *June* 30, 12′ before V. manè Dig.
9½ center to the ſouth.
2093 *July* 10, 20′ before I. P. M. Dig.
10¾ center to the north.
2146 *Feb.* 26, 15′ paſt V. P. M. Dig.
9½ center to the ſouth.
2187 *June* 22, 15′ after VII. manè Dig.
10½ center to the ſouth.
2200 *March* 29, 18′ after V. P. M. Dig.
11¾ center a little north.
2381 *July* 6, 40′ after XI. manè Dig.
central and total ferè.
2435 *Auguſt* 8, 10′ before X. manè Dig.
8, center to the north.
2551 *May* 19, 10′ after V. P. M. Dig.
6¾ center to the ſouth.

Computed from Leadbetter's *Tables.*